

## CLAIMS

1. A rechargeable lithium battery including a negative electrode made by sintering a layer of a mixture of active material particles containing silicon and/or a silicon alloy and a binder on a surface of a conductive metal foil current collector, a positive electrode and a nonaqueous electrolyte, characterized in that said nonaqueous electrolyte contains carbon dioxide dissolved therein.

2. The rechargeable lithium battery as recited in claim 1, characterized in that said sintering is performed under a non-oxidizing atmosphere.

3. A rechargeable lithium battery including a negative electrode made by sintering, on a surface of a conductive metal foil current collector, a layer of a mixture of a binder and active material particles having a tendency to undergo a porosity increase that advances inside from particle surfaces during charge and discharge, a positive electrode and a nonaqueous electrolyte, characterized in that said nonaqueous electrolyte contains carbon dioxide dissolved therein.

4. The rechargeable lithium battery as recited in any one of claims 1 - 3, characterized in that the amount of carbon dioxide dissolved in said nonaqueous electrolyte is at least 0.001 % by weight.

5. The rechargeable lithium battery as recited in any one

of claims 1 - 3, characterized in that the amount of carbon dioxide dissolved in said nonaqueous electrolyte is at least 0.01 % by weight.

6. The rechargeable lithium battery as recited in any one  
5 of claims 1 - 3, characterized in that the amount of carbon dioxide dissolved in said nonaqueous electrolyte is at least 0.05 % by weight.

7. The rechargeable lithium battery as recited in any one  
of claims 1 - 6, characterized in that carbon dioxide is further  
10 contained in an inner space of the battery.

8. The rechargeable lithium battery as recited in any one  
of claims 1 - 7, characterized in that said nonaqueous electrolyte contains a cyclic carbonate.

9. The rechargeable lithium battery as recited in any one  
15 of claims 1 - 7, characterized in that said nonaqueous electrolyte contains a mixed solvent of a cyclic carbonate and a chain carbonate.

10. The rechargeable lithium battery as recited in claim  
8 or 9, characterized in that said cyclic carbonate includes  
20 ethylene carbonate and/or propylene carbonate.

11. The rechargeable lithium battery as recited in claim  
8 or 9, characterized in that said cyclic carbonate is ethylene carbonate.

12. The rechargeable lithium battery as recited in claim  
25 8 or 9, characterized in that said cyclic carbonate is propylene

carbonate.

13. The rechargeable lithium battery as recited in any one of claims 9 - 12, characterized in that said chain carbonate includes at least one of dimethyl carbonate, diethyl carbonate  
5 and methyl ethyl carbonate.

14. The rechargeable lithium battery as recited in any one of claims 1 - 13, characterized in that said nonaqueous electrolyte further contains a fluorine-containing compound.

15. The rechargeable lithium battery as recited in claim  
10 14, characterized in that said fluorine-containing compound is a fluorine-containing lithium salt.

16. The rechargeable lithium battery as recited in claim 15, characterized in that said fluorine-containing lithium salt is  $\text{LiXF}_y$  (wherein X is P, As, Sb, B, Bi, Al, Ga or In; y is 6  
15 if X is P, As or Sb and y is 4 if X is B, Bi, Al, Ga or In) or  $\text{LiN}(\text{C}_m\text{F}_{2m+1}\text{SO}_2)(\text{C}_n\text{F}_{2n+1}\text{SO}_2)$  (wherein m and n are independently integers of 1 - 4).

17. The rechargeable lithium battery as recited in claim 15, characterized in that said fluorine-containing lithium salt  
20 is at least one selected from  $\text{LiPF}_6$ ,  $\text{LiBF}_4$  and  $\text{LiN}(\text{C}_2\text{F}_5\text{SO}_2)_2$ .

18. The rechargeable lithium battery as recited in any one of claims 1 - 17, characterized in that said active material particles have a mean particle diameter of 10  $\mu\text{m}$  or below.

19. The rechargeable lithium battery as recited in any  
25 one of claims 1 - 18, characterized in that said current collector

has an arithmetic mean surface roughness Ra of at least 0.2  $\mu\text{m}$ .

20. The rechargeable lithium battery as recited in any one of claims 1 - 19, characterized in that said current collector comprises a copper foil, a copper alloy foil or a metal foil  
5 having a copper or copper alloy surface layer.

21. The rechargeable lithium battery as recited in any one of claims 1 - 19, characterized in that said current collector comprises an electrolytic copper foil, an electrolytic copper alloy foil or a metal foil having an electrolytic copper or copper  
10 alloy surface layer.

22. The rechargeable lithium battery as recited in any one of claims 1 - 21, characterized in that said binder remains even after a heat treatment for the sintering.

23. The rechargeable lithium battery as recited in any  
15 one of claims 1 - 22, characterized in that said binder comprises polyimide.

24. The rechargeable lithium battery as recited in any one of claims 1 - 23, characterized in that said active material particles are composed of silicon.

20 25. The rechargeable lithium battery as recited in any one of claims 1 - 24, characterized in that an electric conductor is mixed in said mixture layer.

26. A method for fabricating a rechargeable lithium battery including a negative electrode, a positive electrode and a  
25 nonaqueous electrolyte, characterized as comprising the steps

of:

providing a layer of a mixture of active material particles containing silicon and/or a silicon alloy and a binder on a surface of a conductive metal foil as a current collector and sintering  
5 the mixture layer while being placed on said surface of the conductive metal foil to prepare said negative electrode;

dissolving carbon dioxide in said nonaqueous electrolyte;

and

assembling a rechargeable lithium battery using said  
10 negative electrode, positive electrode and nonaqueous electrolyte.

27. The method for fabricating a rechargeable lithium battery as recited in claim 26, characterized in that said sintering is performed under a non-oxidizing atmosphere.

15 28. The method for fabricating a rechargeable lithium battery as recited in claim 26 or 27, characterized in that the step of dissolving carbon dioxide in the nonaqueous electrolyte includes a step of blowing gaseous carbon dioxide into the nonaqueous electrolyte.

20 29. The method for fabricating a rechargeable lithium battery as recited in any one of claims 26 - 28, characterized in that the step of assembling a rechargeable lithium battery includes a step of assembling a rechargeable lithium battery under the atmosphere including carbon dioxide.